

Notice of Allowability

Application No.

10/716,681

Examiner

Thanhha Pham

Applicant(s)

RUELKE ET AL.

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 09/27/2005 and interview dated 12/05/2005 & 12/08/2005.
2. ☒ The allowed claim(s) is/are 1-6,13-18,21,22 and 24-26.
3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☒ All b) ☐ Some* c) ☐ None of the:
 1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).
 - * Certified copies not received: _____.

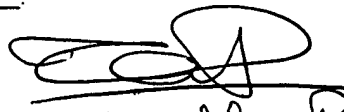
Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413), Paper No./Mail Date 12/08/2005.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____


Thanhha Pham

This Office Action is in response to Applicant's Amendment dated 09/27/2005 and interview dated 12/05/2005 & 12/08/2005.

EXAMINER'S AMENDMENT

A. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mike Amerson on 12/05/2005 and 12/08/2005.

B. The application has been amended as follows:

Replace claims 1, 13 and 24 as below:

In claim 1:

1. A method, comprising:
 - forming a nitrogen-enriched silicon carbide-containing layer over a substrate;
 - modifying at least an exposed surface of said nitrogen-enriched silicon carbide containing layer by treating the exposed surface with an inert plasma atmosphere;
 - forming a low-k dielectric layer over said nitrogen-enriched silicon carbide-containing layer;
 - performing a patterning process to form a via in said low-k dielectric layer by means of a first resist mask;

after forming said via, performing an out-gassing step to remove contaminants from said nitrogen-enriched silicon carbide-containing layer; and

after performing said out-gassing step, performing a patterning process to form a trench in said low-k dielectric layer by means of a second resist mask.

In claim 13:

13. A method of forming a metallization layer, the method comprising:

depositing a nitrogen-containing low-k barrier layer over a substrate;

modifying a surface of said nitrogen-containing low-k barrier layer by introducing noble gas atoms into a region of said nitrogen-containing low-k barrier layer by exposing said nitrogen containing low-k barrier layer to a plasma treatment comprising a noble gas;

depositing a low-k dielectric layer over said nitrogen-containing low-k barrier layer;

patterning said low-k dielectric layer by a lithography process, wherein said modified surface reduces resist poisoning in said lithography process, wherein patterning said low-k dielectric layer includes forming a via in said low-k dielectric layer by means of a first resist mask;

after forming said via, performing an out-gassing step to remove contaminants from said nitrogen-containing low-k barrier layer;

after performing said out-gassing step, forming a trench in an upper portion of said low-k dielectric layer by means of a second resist mask; and

forming a metal region in said via and said trench in said patterned low-k dielectric layer.

In claim 24:

24. A method, comprising:

forming a barrier layer comprised of a nitrogen-enriched silicon carbide-containing layer over a substrate;

exposing a surface of said barrier layer to a plasma ambient comprising a noble gas to thereby increase a concentration of atoms of said noble gas in a region of said barrier layer having a depth, wherein said depth ranges from approximately 0.3-3 nm;

forming at least one low-k dielectric layer above said barrier layer after said surface of said barrier layer is exposed to said plasma ambient;

patterning said at least one low-k dielectric layer by a lithography process, wherein said exposed surface reduces resist poisoning in said lithography process, wherein patterning said at least one low-k dielectric layer includes:

forming a via in said at least one low-k dielectric layer by means of a first resist mask;

after forming said via, performing an out-gassing step to remove contaminants from said nitrogen-enriched silicon carbide-containing barrier; and

after performing said out-gassing step, forming a trench in an upper portion of said at least one low-k dielectric layer by means of a second resist mask; and

forming a conductive interconnection in said at least one low-k dielectric layer.

Allowable Subject Matter

- C. Claims 1-6, 13-18, 21-22, and 24-26 are allowed.
- D. The following is an examiner's statement of reasons for allowance:
- Recorded Prior Art fails to disclose or suggest the combination of the process steps as recited in the base claim 1 including: after forming said via, performing an out-gassing step to remove contaminants from said nitrogen-enriched silicon carbide-containing layer; and after performing said out-gassing step, performing a patterning process to form a trench in said low-k dielectric layer by means of a second resist mask.
 - Recorded Prior Art also fails to disclose or suggest the combination of the process steps of method for forming metallization layer as recited in the base claim 13 including: after forming said via, performing an out-gassing step to remove contaminants from said nitrogen-containing low-k barrier layer; and after performing said out-gassing step, forming a trench in an upper portion of said low-k dielectric layer by means of a second resist mask.
 - Recorded Prior Art fails to disclose or suggest the combination of the process steps as recited in the base claim 24 including: after forming said via, performing an out-gassing step to remove contaminants from said nitrogen-enriched silicon carbide-containing layer; and after performing said out-gassing step, forming a trench in an upper portion of said at least one low-k dielectric layer by means of a second resist mask.

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E. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

F. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (571) 272-1696. The examiner can normally be reached on Monday and Thursday 9:00AM - 9:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, consisting of a series of loops and a long horizontal stroke extending to the right.

Thanhha Pham